

CLAIMS

What is claimed is:

- 10 1. A radiation shielded multi-chip module, comprising:
 - (a) a base constructed from a radiation shielding material with a plurality of non-conducting feed throughs; and
 - (b) a substrate with a plurality of integrated circuit devices attached to a top side of said substrate and a plurality of integrated circuit devices attached to a bottom side of said substrate, wherein said substrate is attached to the inside of said base; and
 - 15 (c) a lid constructed from a radiation shielding material, wherein said base is secured to an inner surface of said base member; and
 - (d) a plurality of package leads passing through said plurality of non-conducting feed throughs in said base and electrically attached to said plurality of integrated circuit devices.
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2. A radiation shielded multi-chip module according to claim 1, wherein said radiation shielding material is comprised of a high Z/low Z alloy.
- 25 3. A radiation shielded multi-chip module according to claim 1, wherein said radiation shielding material is comprised of a high Z material.
4. A radiation shielded integrated circuit device according to claim 1, wherein said radiation shielding material is comprised of a Copper Tungsten alloy.
- 30 5. A radiation shielded multi-chip module according to claim 1, wherein said radiation shielding material is comprised of Tungsten.
- 35 6. A radiation shielded multi-chip module according to claim 1, wherein a plurality of die attach slugs composed of radiation shielding material are disposed between and attached to said substrate and said plurality of integrated circuit die.
7. A radiation shielded multi-chip module as recited in claim 1, wherein a thickness of said base and said lid is determined by,
 - 40 a calculation of the radiation for a specific task; and
 - a total radiation dose tolerance of all integrated circuits attached to said base; and
 - a radiation transport calculation, wherein the thickness of said shielding material is calculated as a function of said radiation for a specific task; said total radiation dose tolerance, and the density and thickness of said shielding material and is derived from said radiation transport calculation.
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8. A radiation shielded multi-chip module, comprising:
 - (a) a top lid and side-wall combination composed of a radiation shielding material; and
 - (b) a bottom lid and side-wall combination composed of a radiation shielding material;

- 5 and
- (c) a substrate with a plurality of integrated circuit devices attached to a top side of said substrate and a plurality of integrated circuit devices attached to a bottom side of said substrate, wherein said substrate is attached to said top and said bottom lid and side-wall combination by a seal ring on said substrates top and bottom surface; and
 - 10 (d) a plurality of package leads attached electrically to said plurality of integrated circuit devices and mechanically attached to said substrate.

9. A radiation shielded multi-chip module as recited in claim 8, wherein the thickness of said base and said lid is determined by,
- 15 (a) a calculation of the radiation for a specific task; and
 - (b) a total radiation dose tolerance of all integrated circuits attached to said base; and
 - (c) a radiation transport calculation, wherein the thickness of said shielding material is calculated as a function of said radiation for a specific task, said total radiation dose tolerance, and the density and thickness of said shielding material and is derived from
 - 20 said radiation transport calculation.

10. A radiation shielded multi-chip module as recited in claim 8, wherein said radiation shielding material is comprised Tungsten.

- 25 11. A radiation shielded multi-chip module as recited in claim 8, wherein said radiation shielding material is comprised of a high Z/low Z material.

12. A radiation shielded multi-chip module as recited in claim 8, wherein said radiation shielding material is comprised of a Copper Tungsten alloy.

- 30 13. A radiation shielded multi-chip module as recited in claim 8, wherein said radiation shielding material is comprised of a high Z material.

14. A radiation shielded multi-chip module as recited in claim 8, wherein said seal ring makes a hermetic seal between said top and said bottom lid and side-wall combination and said substrate.

15. A radiation shielded multi-chip module as recited in claim 8, wherein said top lid and side-wall combination or said bottom lid and side-wall combination has a small hole to allow for venting during sealing, and said small hole is subsequently sealed to maintain a hermetic seal.

16. A radiation shielded multi-chip module as recited in claim 8, wherein said plurality of integrated circuit devices are electrically attached by a plurality of screened interconnects within said substrate, said screened interconnects are electrically attached to said plurality of package leads.

17. A radiation shielded multi-chip module, comprising:

- (a) A top side-wall; and
- (b) A bottom side-wall; and
- (c) A substrate comprised of a plurality of integrated circuit devices attached to a top side

5 of said substrate and a plurality of integrated circuit devices attached to a bottom side of said substrate, wherein said top side of said substrate is attached to the bottom side of said top side-wall, and said bottom side of said substrate is attached to the top surface of said bottom side-wall; and

10 (d) A top lid constructed from a radiation shielding material, wherein said top lid is hermetically sealed to the top surface of said top side-wall; and

(e) A bottom lid constructed from a radiation shielding material, wherein said bottom lid is hermetically sealed to the bottom surface of said bottom side-wall; and

(f) A plurality of package leads attached electrically to said plurality of integrated circuit devices.

15 18. A radiation shielded multi-chip module as recited in claim 17, wherein said top lid and said bottom lid are composed of a high Z/ low Z alloy.

20 19. A radiation shielded multi-chip module as recited in claim 17, wherein said top lid and said bottom lid are composed of a high Z material.

20. A radiation shielded multi-chip module as recited in claim 17, wherein said top lid and said bottom lid are composed of a Copper Tungsten alloy.

25 21. A radiation shielded multi-chip module as recited in claim 17, wherein said top lid and said bottom lid are composed of a Tungsten.

22. A radiation shielded multi-chip module as recited in claim 17, wherein

30 (a) said top lid is comprised of
(1) a first top lid which is composed of a packaging material and
(2) an inner top lid composed of a radiation shielding material attached to said first top lid, wherein said first top lid makes a seal with said top surface of said side wall; and

35 (b) said bottom lid is comprised of
(1) a first bottom lid which is composed of a packaging material and
(2) an inner bottom lid composed of a radiation shielding material and attached to said first bottom lid, wherein said first bottom lid makes a seal with said bottom surface of said side wall.

40 23. A radiation shielded multi-chip module as recited in claim 22, wherein said radiation shielding material is comprised of a high Z/ low Z material.

24. A radiation shielded multi-chip module as recited in claim 22, wherein said radiation shielding material is comprised of a Copper Tungsten alloy.

45 25. A radiation shielded multi-chip module according to claim 17, further including, a plurality of die attach slugs composed of radiation shielding material that are disposed between and attached to said substrate and said plurality of integrated circuit die.

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26. A radiation shielded multi-chip module as recited in claim 17, wherein a shielding ring composed of a radiation shielding material is attached to said top and said bottom surface of said substrate.

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27. A radiation shielded multi-chip module, comprising:

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- (a) a dual cavity base with a top well and a bottom well and with a plurality of non-conducting feed throughs; and
- (b) a top substrate with a plurality of integrated circuit devices attached to a top side of said top substrate, wherein said top substrate is attached to the inside surface of said top well on said dual cavity base; and
- (c) a bottom substrate with a plurality of integrated circuit devices attached to a bottom side of said bottom substrate wherein said bottom substrate is attached to the inside surface of said bottom cavity of said dual cavity base; and
- (d) a top lid comprised of radiation shielding material which is attached to said top well of said dual cavity base forming a sealed cavity; and
- (e) a bottom lid comprised of radiation shielding material which is attached to said bottom well of said dual cavity base forming a sealed cavity; and
- (f) a plurality of package leads passing through said plurality of non-conducting feed throughs in said dual cavity base and electrically attached to said plurality of integrated circuit devices.

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28. A radiation shielded multi-chip module as recited in claim 27, wherein said radiation shielding material is comprised of a high Z/low Z material.

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29. A radiation shielded multi-chip module as recited in claim 27, wherein said radiation shielding material is comprised of a Copper Tungsten alloy.

30. A radiation shielded multi-chip module as recited in claim 27, wherein said radiation shielding material is comprised of Tungsten.

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31. A radiation shielded multi-chip module as recited in claim 27, wherein said radiation shielding material is comprised of a high Z material.

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32. A radiation shielded multi-chip module as recited in claim 27, wherein

(a) said top lid is comprised of

- (1) a first top lid which is composed of a packaging material and
- (2) an inner top lid composed of a radiation shielding material attached to said first top lid, wherein said first top lid makes a seal with a top surface of said dual cavity base; and

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(b) said bottom lid is comprised of

- (1) a first bottom lid which is composed of a packaging material and
- (2) an inner bottom lid composed of a radiation shielding material attached to said first bottom lid, wherein said first bottom lid makes a seal with a bottom surface of said dual cavity base.